

## Description

### [External Frame Backpack]

#### BACKGROUND OF INVENTION

[0001] The present invention pertains generally to backpacks used by backcountry hikers who must carry large amounts of gear. Many types of backpacks are available on the market to meet this need and are generally divided into three categories 1) knapsacks 2)internal frame packs and 3) external frame packs. Hikers strive to find a pack that can carry the required gear weight with a minimal amount of pack weight and a maximum amount of personal comfort.

[0002] A backpack is the primary piece of gear needed by a long distance hiker. Differences in human body sizes and shapes make it very difficult to create a backpack that fits a wide range of hikers and delivers a comfortable hiking experience. The first popular type of backpack was the knapsack, a fabric bag with two shoulder straps that place the weight of the pack on the hiker's shoulders. This causes discomfort to most hikers thus limiting the knap-

sack to lightweight pack loads. The external frame pack was developed to improve the knapsack. The knapsack was attached to a ladder-like frame usually made of wood or aluminum. The frame had two shoulder straps and a hip belt attached. By tightening the hip belt the hiker can cause a big portion of the pack weight to be borne by the pelvic bone structure, relieving the pressure on the shoulders.

- [0003] The external frame pack is widely used today. The drawbacks of the external frame backpack are the rigid external frame that can limit the outdoor spaces a hiker can squeeze through and the stiffness of the frame that can restrict some bending movements of the hiker. Many hikers also find the hip belt of the external frame pack can cause pain in the hip bones. Another drawback is many external frame backpacks are heavy as the result of a multiplicity of frame tubes, adjustment mechanisms, and extra padding to enable a comfortable fit on a range of different body sizes and shapes.
- [0004] The internal frame pack is the most recent innovation in backpack design. Rather than taking a knapsack and attaching it to an external frame, an internal frame is attached to the material of a modified knapsack. No frame

is visible from the outside. This allowed the pack designer to mount bendable stays into the pack bag that can be curved to fit the entire back of each individual hiker. This produced an increase in comfort for many hikers. The internal frame pack is currently the most popular offering in the marketplace.

[0005] The internal frame pack has several drawbacks that include a relatively heavy weight, poor ventilation of the hiker's back, and difficulty packing and unpacking. The internal frame backpack is relatively heavy due to the use of many layers of fabric and padding to contain the internal frame and to pad the hip belt and shoulder belts. Typically such a pack will weigh seven pounds or more. The pack bag is constructed from heavy fabric, typically 400 and 1000 denier nylon, in order to give it shape and to transfer loads from the rear of the pack to the internal frame at the front. The internal frame transfers most of this weight down to the hip belt. The padded front face of the pack is held tightly against almost the entire back of the hiker. This padding produces excess sweating and discomfort from constantly wet skin. The pack bag is difficult to pack and unpack because it is effectively a single tall narrow volume. Items at the bottom cannot be re-

trieved unless all items above are removed. Some internal frame backpack designs include side or rear pouches to partially alleviate this problem, but they stick out and make trail navigation more difficult. The pack will usually have straps to compress the bag to compact internal gear and keep it from shifting or moving around with each hiking step. These straps add weight and complexity and reduce reliability, since they are one more thing that will break.

[0006] While the backpacks cited in the following references each offer a novel improvement, these references also reveal the continuing disagreements in the backpacking community in the most fundamental areas of pack design, such as which part of the human body is best at bearing the weight of a backpack, or how to best position a waist belt. As a result, proffered improvements in design rarely result in any improvement in comfort or usability for the hiker in the field and very rarely show up in retail products. If offered in commercially available backpacks, the novel improvement is usually overwhelmed or cancelled out by a multiplicity of remaining defects. The backpack of the present invention offers a combination of novel improvements including a tapered external frame with strong but

ultralight joints, a bag with individual compartments that share no common fabric panels, a waist belt geometry that directs the pack weight into the lumbar region of the body, and a lumbar pad that swivels to become a seat. However, in addition to its novel improvements, the present invention integrates a multiplicity of designs from the established art to work together as a functional system to enable real benefits to the hiker from the novel improvements of the present invention.

[0007] Weight Transfer Devices -- For instance, 4,369,903 by Wilkes offers a means of adding tubing to the external frame to transfer weight to a hip belt. Gleason in 6,179,188; 5,904,282 and 5,762,251 offers a similar technology. Earlier, Owens utilized tubes to the hip belt in 3,581,961 and so did Wilkes in 4,369,903. All of these increase the weight and complexity of the backpack with little or no improvement in comfort since the amount of weight on the hips is determined by the adjustment of the shoulder straps. In addition, static analysis of force vectors reveals that adding tubes only adds weight; a new tube cannot cause a weight transfer. All the weight of a backpack must be born by compressing the human body at one or more points. If the hiker is standing upright,

only the torso or shoulders can be compressed to bear weight. At best, adding tubes can shift this compression from the stomach around toward the hip region, or from the shoulders to the lumbar region. But the total bodily compression (another measure of discomfort) remains the same for any pack design that has its center of gravity the same distance behind the hiker's spinal column

- [0008] Multiple Compartments -- The Modular Backpack by Von Neuman (6,189,750) offers multiple compartments, but these multiple compartments are not attached to an external frame, thus producing a backpack that can carry little weight without discomfort. Mack in 3,219,243 shows an external frame with framing elements for shelves. This adds weight. Deutsch in 5,628,443 offers slip on/off compartments that attach to a traditional rectangular central bag. This adds excessive weight since such small volume compartments and connectors have a high weight to volume ratio. Bentsen in 6,161,739 utilizes fabric shelves inside a rectangular bag with a complex and heavy internal metal frame. Patent application 2001/0017307 describes a backpack with an internal tubular frame that can collapse. The frame supports a bag with compartments. The compartments share a fabric shelf that allows gear to

protrude between compartments and allows leaks to pass into compartments below. In contrast, the present invention offers compartments that are individual cylinders that share no common fabric panels. In the late 1960's the Gerry Company sold an external frame backpack with a fabric bag divided into four stitched horizontal sections accessible with zippers with shared fabric dividers. This pack utilized a thin mesh band at lumbar level and a two piece hip belt attached to the side tubes of the frame. This was very light, but created pressure points on the hip bones that limited the weight that could be carried comfortably. The website [www.thewildernesswanderer.com](http://www.thewildernesswanderer.com) sells a modular backpack called the Wilderness Wanderer that has an external metal frame that has a rigid bottom loop of tubing, or shelf. The aluminum frame has a traditional ladder geometry with a pair of parallel vertical tubes with multiple horizontal cross tubes where the present invention has a frame that is narrower at the top to better conform to the human body shape and to force weight to be carried down lower. The Wilderness Wanderer frame can have a series of different size bags attached to it. These bags are pinned in fixed positions to the frame. The weight of the gear is supported by the pins since the bags

cannot slide down on the frame as is possible on the present invention. The bottom shelf does not support the weight of the gear inside the bags, serving only to help keep the pack upright when set on the ground. The backpack is very heavy due to the thick fabric, a rectangular bag mounted up high, and a large metal frame. The Wilderness Wanderer pack will tip over on uneven or rocky ground due to the high center of gravity of a fully loaded pack. The present invention has a frame that is narrower in width at the top with typically four cylinders to store gear where the top cylinder will hold 500 cubic inches, and the bottom cylinder will hold 1600 cubic inches. This means the hiker will typically have three times as much weight in the bottom of the pack as in the top. This significantly lowers the center of gravity of a fully loaded pack, enabling it to stand upright easily on its bottom shelf when placed on uneven ground

[0009] The backpack disclosed by Gregory in 5,564,612 shows an external frame with parallel tubular side rails connected with plastic castings and a closed top that does not allow hanging hiking gear, as does the present invention. The Gregory pack has a single bag utilizing side pockets, the bag being loosely attached to the side tubes at several

attachment points and suspended from a loop at its top. The stresses on the fabric and seams at this top loop are very high, requiring the use of heavy fabric for durability. The Gregory pack frame has a bottom loop but this loop is intended to support a sleeping bag and does not ride in contact with the pack bag and does not support any bag weight. The hip belt attaches in part to a plastic casting at the center of the back, but this casting is not curved to fit the lumbar region, instead relying on thick padding in the hip belt for comfort.

[0010] The Front Pack disclosed by Stanford in 4,480,775 offers a rigid bottom loop intended to support the weight of a loaded bag. However, this front pack places no weight onto a waist belt, putting all weight on two shoulder straps and is not paired with a backpack as enabled by the present invention. The Ergonomically Enhanced Backpack by Lemire in 6,179,187 discloses a knapsack with a dorsal plate that is similar to the lumbar insert of the present invention, however this knapsack lacks the external weight bearing tubular frame of the present invention that is necessary to carry heavy loads in comfort. The dorsal plate is intended to intimately contact the hiker's back from below the shoulder blades to the pelvic region. The large area of

this dorsal plate makes it both heavy and hot and also unlikely to fit the large range of human body sizes and shapes.

- [0011] The invention in 4,561,578 (Bell) discloses an external tubular weight bearing frame with a set of balance rods which are intended to manipulate the shoulder belts. The balance rods are a heavy and complex means of adjusting the shoulder belts where the present invention offers automatic shoulder belt adjustment with no added weight or complexity. The Bell device also places a large portion of the pack weight upon the shoulders, causing discomfort in the majority of hikers.
- [0012] The Kober disclosure of 5,628,437 offers a combination of a backpack and a seat. The seat cushion is bulky and heavy and serves no function while the device is used as a backpack. The disclosure of 4,489,866 also shows a pack that has swiveling tubes that can be configured into a chair. The present invention allows its necessary lumbar padding to be swiveled and also used as a seat cushion and adds no tubing for the exclusive enablement of a seat.
- [0013] The Tramper's Pack of 6,276,584 discloses an internal frame pack that intends to focus the weight of the pack

on the lumbar region. However, this design lacks both the external tubular frame and the multi-compartment bag of the present invention, making it difficult to implement without excessive bag weight to attempt to focus all weight zones of the pack into the lumbar region.

- [0014] Patent application 2002/0100778 pictures a molded pack frame that includes a curved lumbar panel that pivots within the outer frame. This pack frame converts into a chair. The weight of a molded frame of this complexity will be very high and will overcome any benefits of its claimed features. The molded frame does not use a bag with compartments sharing no fabric panels. The molded frame is not narrower at the top to improve the center of gravity. The conversion to a chair requires removing the pack bag where the present invention leaves the bag in place and uses the pack bag as a padded seat back.
- [0015] The patent application 2002/0108982 offers a knapsack without an external frame and adds control rods to decouple the hip motions from the backpack. This adds weight and complexity that the present invention cures by using a stiff lumbar insert with stiffly attached belt that encircles and compresses the torso above the pelvic bones.

[0016] The invention of application 2002/0074373 adds a bionic mechanism to tighten the hip belt using the mechanical advantage of pulleys. This purports to so tighten the hip belt that the wearer can bear many times the normal pack weight. The drawback of this device is the weight and complexity that serves only to make the waist belt far too tight for any hiker to bear. The present invention uses a hip belt with a 2:1 mechanical advantage at the front attachment point as is typically found on low cost exercise belts. This 2:1 advantage is sufficient to easily tighten the waist belt for the optimal compression of the torso and can be, with only a 2:1 advantage, over-tightened to the point of discomfort for even the most fit hiker.

#### **SUMMARY OF INVENTION**

[0017] The invention is a hiker's backpack utilizing a rigid external frame to which is attached a multi-compartment bag comprised of multiple horizontal cylinders that share no common structural panels. The bag is mounted in a way that reduces stress on the seams thus allowing thinner and lighter materials to be used. The frame is typically comprised of metallic and composite elements and exhibits very little flex. The frame has a horizontal bottom loop comprising a shelf that bears the weight of the bags

and also allows the loaded backpack to stand by itself on the ground. The two side tubes of the frame are slanted inward towards each other at the top lowering the load's center of gravity and making the pack narrower and easier to maneuver in the brush. The two side tubes rise above the topmost compartment of the bag to provide a hanging fixture for other hiking gear. The frame has a waist belt that can incorporate an ergonomically curved polymer insert to direct the majority of the weight of a loaded pack onto the lumbar curve of the spine. The insert is padded with a panel of cushioning material that can be repositioned to form the base of a camp chair while the bag forms the back of the chair.

#### **BRIEF DESCRIPTION OF DRAWINGS**

- [0018] Fig. 1 – Side view of frame and bag as worn by a hiker.
- [0019] Fig. 2 – Front view of frame with all belts showing the V-tube attachment and lumbar padding.
- [0020] Fig. 3a – Frontal view of hiker wearing backpack with a frontpack.
- [0021] Fig. 3b – Side view backpack used as a camp chair.
- [0022] Fig. 4 – Detail view of waist belt with lumbar element and attachment means.

[0023] Fig. 4a – Cross-sectional view of means of attaching waist belt to frame showing lumbar element, external frame, hook & loop fasteners and padding.

[0024] Fig. 4b – Detail view of 2:1 waist belt front attachment means.

[0025] Fig. 5 – Rear view of bag as mounted on frame.

[0026] Fig. 6 – Side view of backpack showing "C"-tube attachment devices.

[0027] Fig. 6a – Cross-sectional view of "C"-Tube attachment device.

#### **DETAILED DESCRIPTION**

[0028] Referring to Fig. 1, the backpack of the present invention is a backpack for humans to carry a load, utilizing a rigid external frame 26 to which is attached a bag with multiple compartments 12. The bag 12 is typically constructed of waterproof fabric, but can alternatively be constructed with plastic films, netting, mesh, thin metal sheet. or molded plastic. The bag 12 has multiple compartments of preferably cylindrical geometry mounted horizontally to the frame where the compartments share no common structural panels. The shape of the individual compartments can be constructed to be other than cylindrical, but

after being stuffed with gear, an unconstrained compartment of lightweight fabric will assume a nearly cylindrical shape. A cylindrical geometry will achieve the lowest bag weight for a given volume.

[0029] The frame is typically comprised of metallic and composite elements, usually tubular, but can be made with any light weight material, such as wood, magnesium, aluminum, carbon fiber, fiber glass, and molded plastics. The frame is rigid to efficiently transmit load vectors to the lumbar region of the hiker's back. The frame has a bottom loop 15 forming a shelf that bears the weight of the loaded bags and also allows the backpack to stand by itself on the ground. The two side tubes of most external frame backpacks are parallel in the rear view and are curved to match the human spine. In Fig. 2, the two side tubes 24 of the frame 26 of the present invention can be curved to match the spine but can also be straight; but, in either case, are slanted in the rear view to be narrower at the top to lower the loaded pack's center of gravity and make navigating on tight trails easier. The two side tubes 24 rise above the topmost compartment of the bag 12 to provide a hanging fixture for other hiking gear such as a front hydration pack 32 in Fig. 3a, hiking sticks, or a dog

leash. The front hydration pack 32 has two straps that hang from the top of the two sides tubes 24 that extend above the junction of the V-tubes 23. In addition, the bottom of the front pack attaches to the waist belt 13 with a strap or buckle that bears the majority of the weight of the front pack. The weight of the front pack counterbalances an equal weight of the backpack, resulting in the hiker being able to stand more upright to maintain the center of gravity necessary for comfortable walking.

- [0030] The frame 26 has attached to it near the bottom a waist belt 13 that can incorporate an anatomically curved insert 55 shown in Fig. 4a to bear the majority of the weight of a loaded pack on the lumbar curve of the spine, as shown in Fig. 4 and 4a. The insert 55 is preferably by Flex Form, US Patent 5,445,601. The insert 55 is padded with a panel of cushioning material 25 that can be swiveled about the anterior tube 31 of the bottom loop to form the base of a camp chair, Fig. 3b, with the pack bag 12 forming the back of the chair.
- [0031] In Fig. 2 and Fig. 4b, the external frame 26 of the present invention also has two shoulder straps 21 attached to it. The ends of the shoulder straps attach near the bottom and near the top of the frame. The preferred bottom at-

tachment point is to a horizontal tube 51b that runs between the two side tubes 24. Or, alternatively, the shoulder strap lower end can be bolted or pinned to other frame tubes. The top section of the external frame may also have one or more horizontal tubes between the two side tubes. In addition, a V shaped tube 23 is attached between the side tubes at the top. The top end of each shoulder strap 21 is attached in a manner that allows it to slide along the V tube member 23 on each side of the hiker's neck. This allows the hiker to change the width of the shoulder strap mounting point while walking to maximize comfort. Or, if left unintended, the shoulder belts tend to slide along the V tube to the optimum position for the hiker; a shorter hiker will see the straps slide down the V tube to a narrow position while a taller and bigger hiker will have a neck and shoulders that will push the attachment points upward and outward.

[0032] On the present invention, the vertical distance between the waist belt 13 and the V tube 23 is greater than the distance found on a typical external frame backpack such as the Kelty models and is such that the shoulder belts do not touch the top of the hiker's shoulders, even for tall hikers. The shoulder straps 21 attach at an upward angle

from horizontal, not a downward angle. This allows one size of backpack to fit all customers. The shoulder straps 21 provide stability to the pack to limit pack movement while walking. The straps 21 provide a weight bearing ability only if they are adjusted very tight to allow the pectoral muscles of the chest to bear some component of the compression force. This high mounting level of the V tube 23 and shoulder straps 21 eliminates one of the biggest complexities of other backpack designs -- the requirement for different size frames to match the differing torso lengths of the human population. The present invention solves this problem in the same manner that the automotive seat/shoulder belt solves an identical problem. The shoulder strap mounting geometry of the present invention is similar to that used in cars for safety belts. While traditional backpacks are offered in many sizes, cars come with only one seat size to fit all drivers. One safety belt and one seat size fits all drivers because the waist belt is adjustable and the shoulder belt does not arch down over the shoulder, it angles straight up across the pectoral region to a high attachment point on the frame of the vehicle. The backpack of the present invention offers a similar geometry allowing it to be offered in only one size that

will fit children and adults, men and women. This allows a family to share or swap backpacks and also reduces inventory costs for manufacturers, distributors, and retailers.

[0033] The frame of the present invention offers several improvements. The two side tubes 24 of the external frame 26 are not parallel in contrast to the external frame packs in the citations which are generally rectangular in the posterior view causing the wide upper section to catch on branches along the trail. The present invention slants the side elements of the frame inward towards each other at the top. This makes the top of the frame narrower than the bottom by typically several inches allowing tight spaces to be negotiated more easily by the hiker. Another advantage of a frame with a narrow top is the resulting smaller volume of the pack bag at the top. This reduces the gear weight in the top of the pack, making it easier for the hiker's natural balancing skills to re-balance the load over his center of gravity with each step, thus reducing or eliminating thousands of small muscle exertions that produce fatigue.

[0034] The frame of a typical external frame backpack will show a loop of metal or a plastic casting across the top to allow

lashing gear on top of the pack bag. The frame of the present invention does not have this loop; the ends of each side tube 24 extend free of the pack bag by several inches, creating a post several inches tall. These two posts are very useful to the hiker as they provide a convenient point from which to hang gear. For instance, many hikers are using one or two telescoping hiking poles to improve hiking stamina. These poles are very inconvenient at times, such as when the hiker needs to use a camera or compass. A hiking pole can be quickly hung from the frame posts 24, even while walking, to free up a hand to use other equipment. Hydration packs 32 are also very popular with hikers and are easily hung from the frame posts 24. Other items like towels, shoes, rain ponchos, and hats are easily hung from the frame posts. The hiker does not have to stop and take his pack off to retrieve an item; this allows the hiker to keep walking at a steady pace and increase the mileage covered each day.

[0035] A critical metric of any backpack is its weight. Every ounce is critical to the distance hiker. The external frame 26 of the invention is typically built from high strength thin wall aluminum tubing and/or carbon fiber tubing. The resulting frame becomes a rigid load transfer diaphragm that

delivers the maximum stiffness at the least weight of any pack design. A typical frame 26 of the present invention will weigh 12 ounces if made of carbon fiber tubing and be capable of carrying a gear load of 75 pounds without distortion. Carbon fiber tubing is very light and stiff but is also very brittle resulting in breakage at the joints when overstressed, for instance, by dropping a fully loaded pack on a rock surface. Rugged joints are achieved by using socket joints for right angle joining of carbon fiber tubes. These joints are bonded with two part marine epoxy filled with phenolic microballons for light weight and silica powder for flexibility and bonding strength. The joint 43 in Fig. 4b shows the horizontal member 51b is inserted into a hole drilled in the vertical member 24 of a larger diameter. The hole in the tubular vertical member 24 is drilled through only the inside wall. The tubular horizontal member 51b is inserted into the hole in vertical member 24 after the hole is filled with epoxy bonding agent. In the case of a frame using all aluminum or magnesium tubing, the tubing joints can alternatively be welded.

[0036] Another improvement is the geometry of the pack bag 12, comprising four horizontal fabric cylinders, such as 61 and 62 in Fig. 6, that are not connected or, alternatively,

loosely connected to each other but are loosely connected to the frame side tubes 24 of the frame 26. These bags rest on a rigid bottom loop or shelf 15 that supports all the gear weight, resulting in almost no stresses on the straps 17 that attach the bag to the frame. Typical external frame backpack designs produce high point loading by using several attachment pins from which all the gear weight must hang. This will ultimately result in torn fabric at the attachment pins. In the late 1960's the Gerry Company sold an external frame backpack with a rectangular fabric bag divided into four horizontal sections accessible with zippers and utilizing sewn-in shared fabric dividers. Such a pack is owned by the inventor and this pack did tear at the immovable attachment pins because it did not utilize a bottom loop on the frame to bear the weight of the loaded pack.

[0037] The fabric bag 12 can be used without the frame as a pack bag for a bicycle, motorcycle, or in a canoe. In this case, the individual cylinders must be connected together. Referring to Fig. 6a, the preferred means of connecting the multiple cylindrical compartments of the bag together is a "C" tube 63 and rod 64 that slip over the fabric of two adjoining cylinders 61 and 62 at any place on the circum-

ference of the fabric cylinder. This allows the multiple compartment bag to be reassembled to easily bend into a curve and conform over a luggage rack on a bicycle or the seat on a motorcycle. When attached to the external frame of the invention, the cylindrical bags can be left unconnected to each other to allow fast removal and re-attachment of a single cylinder during a hiking trip.

[0038] The rigid bottom loop 15 of the frame 26 also allows the pack to stand up on its own when the hiker sets it on the ground where most packs tip over when set down. In addition, the bottom loop 15 has a pad 25 (Fig. 2 and 3b) hinged around the anterior tube 31 of the bottom loop 15. This pad is swiveled forward to pad the lumbar insert 55 when the pack is being worn. The pad 25 can be swiveled to the rear as the pack is set on the ground and used as a seat pad with the pack bag 12 forming the back of a chair. This can reduce the gear weight the hiker is carrying by eliminating the need to carry a camp chair or stool. The pack in this configuration as shown in Figure 3b requires no additional straps or tubing to connect the seat pad to the pack frame. The chair configuration is self-supporting as weight on the seat pad places downward pressure on the anterior tube 31 of bottom loop 15

while weight on the pack bag from leaning back produces an equal upward pressure, thus causing the chair to be stable over a wide range of lean angles.

[0039] The foremost complaint of long distance hikers is pain from the hip belt and shoulder straps of all three categories of packs. The present invention optionally incorporates a lumbar support that can eliminate this complaint in most hikers. In Fig. 4 and 4a, a stiff plastic insert 55 molded to fit the curve of the lumbar region of the body is attached at the center of the frame near the bottom using hook and loop tape 56. The insert 55 is covered with a thin padded panel 25. Traditional external frame packs refer to the horizontal belt as a hip belt. The present invention mounts the belt 13 to the frame at point above the lumbar insert 55. This causes the waist belt 13 to encircle the waist like a cummerbund, instead of hugging the hips. In addition, the waist belt is typically constructed of a foam/fabric laminate that is stiff and holds its shape without wrinkling as it pulls the frame 26 towards the body as it runs behind vertical frame sub-elements 52 . The waist belt is attached to the frame very stiffly using multiple layers of wide hook and loop tape 54 wrapped around horizontal frame tubes 51a and 51b so that the

belt does not twist or flex in the attachment area. Typical backpack belts are attached to the frame with two or four small flexible nylon straps allowing the belt to flop around freely from the frame producing an unstable pack that moves with each step.

[0040] The primary function of the belt 13 is not a means of transferring weight to the hip bones, but becomes a compression strap to stabilize the torso and pull the molded insert 55 and padding 25 tightly against the lumbar curve of the spine. Looking at Fig. 4b, the compression is generated when the hiker pulls strap 42 through loop 41 generating a 2:1 mechanical advantage to shorten the strap. Alternatively, a traditional side-release buckle can be used, instead of the plain loop, to allow a quick release of the waist belt. The end of strap 42 has a hook and loop patch to attach to a mating hook and loop surface on belt 13. The stiffness of the belt-to-frame attachment in Fig. 4 and 4a keeps the frame from vertically twisting the belt 13 and also prevents the frame from rocking from side to side with each step the hiker takes. The combination of a lumbar insert 55 and a stiff attachment allows most of the pack weight to be borne by the lumbar curve of the spine, a point that exhibits little motion during walking and also

the point that is closest to the body's natural center of gravity. In contrast, packs with hip belts designed to transfer weight to the hip bones put the weight at the outer edge of the body at a point that is in constant motion. The waist belt 13 typically produces compression that falls between the top of the pelvic bones and the bottom of the rib cage. This is an effect similar to the belts used by weight lifters and the back belts worn by factory and warehouse workers who must lift heavy weights all day long. The lumbar insert 55 can be removed from the waist belt 13 by peeling the hook and loop tape 56 apart and can be reattached an inch or two up or down, thus positioning the waist belt to maximize the personal comfort of each individual hiker. In Fig. 2, backband 22 is typically a hook and loop strap that wraps around the two side tubes 24 of frame 26. Backband 22 is tensioned by sliding it down the side tubes 24 which diverge towards the bottom of the frame. This eliminates the typical cords and knots needed to tension the backband. The backband 22 prevents the tubes comprising frame 26 from pressing on the hiker's back if the shoulder straps 21 are set to a tight position.

[0041] Referring to Fig. 5 and Fig. 6, the fabric bag 12 solves the

drawback of internal frame packs on the market that are difficult to pack up and unpack. The bag 12 typically has four horizontal compartments, but can utilize as few as one or more than four depending on the needs of the hiker for each trip. Each compartment such as 61 and 62 will have its own full length zipper or hook and loop closure 65 or can alternatively use a radial zipper on one or both ends of the cylindrical compartment. A hook and loop closure will typically also use one or two side release buckles to prevent accidental opening of the hook and loop. The upper cylinders are not as wide as the lower cylinders to match the narrower top of the frame 26 near the hiker's shoulders. Each compartment is sewn into a cylinder independently and then attached to the frame 26 with hook and loop tapes 17 to form the final pack bag 12. Or, alternatively, the cylinders can also be attached to each other using the C-tube 63 and 64 in Fig. 6a, or the cylinders can be sewn to each other. This geometry produces a bag that has no shared panels of fabric. This is an improvement over pack bags that utilize sewn-in dividers or multiple pockets. Such bags allow gear packed into one section to intrude into the space of another section and typically produce high stresses on the internal seams re-

sulting in tears or pulled seams. The individual cylinders are typically made with waterproof coated nylon thus also delivering the benefit of liquid spills being confined to only one cylinder, preventing, for instance, stove fuel from contaminating all the gear, as would happen in a typical pack bag. The individual cylinders of the bag 12 of the present invention are not attached firmly to the frame at any point. Mounting straps 17 are free to float up and down on the side tubes 26 of the frame. The bottom loop shelf 15 of the frame supports almost all the weight of the gear. This reduces the stresses on the fabric and the seams of the cylinders to a very low level, allowing the use of thinner, lighter fabric without reducing reliability. The bag 12 can have lashing pads 66 sewn to the fabric to carry items like a fishing pole or an ice axe. In contrast, the bags of a typical internal frame pack are heavily reinforced because many seams are highly stressed with each hiking step. The bag 12 typically weighs less than one pound where the bag alone of an internal frame pack will typically weigh about four pounds.

[0042] The multiple cylinder bag 12 allows the hiker to choose different widths and diameters to match the pack volume to the gear to be carried on each hiking trip. The cylinders

can stacked on the frame without any cylinder-to-cylinder attachment. For a more rigid bag, the cylinders can be attached to each other. The attachment interface between two cylinders such as 61 and 62 is generally towards the rear plane of the pack, but can be at any radial position between the gear access zipper 65 and the loops 17 that attach the fabric cylinder to the frame 26. The preferred attachment method is a "C" tube 63 and rod 64 device that slips over a fold in the fabric of the two adjoining cylinders. The "C" tube and rod device eliminates water leaks from sewing needle punctures. This attachment device can be moved easily by the hiker to optimize the geometry of the bag 12. Or the attachment method can be sewing, hook and loop, tie loops, zipper, or similar methods. Or alternatively, the fabric cylinders can be attached along two lines typically 4 to 6 inches apart radially to construct a more rigid bag that does, however, deliver less volume because the cylinders are constrained from each achieving a fully circular shape.

[0043] The cylindrical shape of the bag compartments is a natural fit with the typically cylindrical shape of hiking gear such as sleeping bags, tents, and sleeping pads. Animal resistant food canisters are typically also cylindrical in

shape. This results in more efficient packing that eliminates wasted volumes. The full-width closure 65 allows immediate access to any gear without disturbing other gear. The closure can utilize a zipper, hook and loop tape, or snap buckles, or a combination.

[0044] While the particular backpack, as herein shown and disclosed in detail, is fully capable of obtaining the objects and providing the advantages above stated, it is to be understood that the presently preferred embodiments are merely illustrative of the invention. As such, no limitations are intended other than as defined in the appended claims.